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(19) (CA) **CANADIAN PATENT** (12)

(54) Tournament Data System

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**Canada**

~~INDIVIDUAL~~  
OR  
TEAM

01 This invention relates to games of skill,  
02 and in particular to a system in which players of  
03 individual electronic games such as video games or the  
04 like can play a tournament.

05 In a tournament, various participants  
06 compete individually or in teams to determine which  
07 participant or team has the most skill at separate  
08 games. The degree of skill is usually evident by  
09 points scored, and in some games, handicaps can be  
10 accorded according to the proficiency of the players  
11 and/or the difficulty of the games. Until now,  
12 however, it was not reasonably possible to allow  
13 players of different kinds of games to enter the same  
14 tournament. As one of the advantages of the present  
15 invention, such a tournament is facilitated. In  
16 addition, individual player handicaps can be  
17 automatically stored and taken into account, and  
18 winners automatically declared and announced.

19 There have been in the past certain kinds  
20 of games which facilitated electronic reporting of  
21 scores to a central location, allowing a central  
22 manager to allocate prizes, as for example described  
23 in U.S. Patent 4,302,010 issued November 24th, 1981 to  
24 AMF Incorporated, which relates to an electronic  
25 bowling scoring system. However this system is  
26 restricted to use in a single bowling hall, in which  
27 the veracity of play of all of the bowlers can be  
28 observed by other participants in the bowling hall or  
29 on the team. However the system cannot be used where  
30 doubt exists who the actual player is. For example if  
31 a person has a private bowling alley with a score  
32 entry terminal connected to the system described in  
33 the aforementioned U.S. patent, it would not be possible  
34 to ensure that the person who is signed up to play the  
35 game in the tournament is actually playing, and  
36 therefore false score data could be entered. In  
37 addition, scores are entered into the score entry  
38



01 terminal manually, which also allows the possibility  
02 of cheating. While this of course would be  
03 unsportsmanlike, it could become very serious if a  
04 valuable prize is to be awarded for high score.

05 Due to the above and other problems, it  
06 has not been possible until now to provide large scale  
07 tournament playing with very diverse player  
08 locations. The present invention provides means for  
09 ensuring with a high degree of security that the  
10 person achieving the score is the assumed person who  
11 is playing.

MULTI-LOCATIONS

12 The present invention, further provides  
13 for the first time a tournament system in which people  
14 of widely varying skills can play different kinds of  
15 games of skill at diverse locations while  
16 participating in the tournament. The games can be  
17 grouped centrally, can be single games scattered at  
18 various locations, and all can be played in a  
19 tournament which is localized, regionalized, national  
20 in scope or, indeed, worldwide. Such tournaments can  
21 be established with single expert players, national  
22 teams, etc., with a high degree of reliability that  
23 any person achieving an indicated score is the actual  
24 person assumed to be playing in the game.

25 Furthermore, as players achieve greater skill, or  
26 change the games which they play, their achievement  
27 levels, which can be reflected in handicaps, can be  
28 stored and applied to games played as the player  
29 chooses to play games in different locations, even  
30 though the locations can be anywhere the games are  
31 situated assuming that they are connectable to the  
32 system described herein.

33 The various games which can be utilized in  
34 the tournament system described herein are  
35 microprocessor based and which transmit their scores,  
36 usually to an electronically operated display, via an  
37 internal bus. Such games include various kinds of

01 video games, microprocessor operated pinball machines,  
02 home computer video games, or the like.

03 Such games which are utilizable for the  
04 present invention transmit their score data signals  
05 to a local display and transmit their control data  
06 signals via the aforementioned bus. In the present  
07 invention a universal interface apparatus connects to  
08 the bus, the interface circuit containing a  
09 microprocessor and local memory. Data signals from  
10 the game (which will be referred to herein generically  
11 as video game, although the invention is not  
12 restricted to commercial video games as such) is  
13 mirrored and stored in the interface memory. Software  
14 or firmware in the interface circuit selects specific  
15 locations in the interface memory where the score data  
16 relating to the local video game is stored, and this  
17 data is transmitted to a central computer via a local  
18 area network, telephone line, or other data link upon  
19 polling or upon other means of access by the central  
20 computer.

21 A large number of such video games can be  
22 connected to the local area network area or via  
23 various data links to the central computer, each being  
24 polled or otherwise accessed at times selectable by  
25 the central computer, for transmission and storage of  
26 achieved scores.

27 Since each game is self-contained,  
28 obviously each game would end at a different time from  
29 the others. The central computer stores the score  
30 which is achieved for comparison with other scores at  
31 a predetermined time, in combination with an unique  
32 code which identifies the player, and which is  
33 obtained as follows.

34 Upon desiring to enter a tournament for  
35 the first time, a player purchases a credit card from  
36 a credit manager. The credit manager transmits  
37 signals representing the value of the number of games  
38

LINK TO  
CENTRAL  
COMP.

PRED. UPLOAD  
TIME

PLAYER INFO  
AT CCD

SEND END OF  
GAME SCORE  
OR ~~PLAY-BY-PLAY~~  
CONTINUOUS  
BUT NOT STORAGE  
OF PLAY-BY-PLAY  
(OARTS), THEN  
TRANSMIT WHEN  
DONE.

01 purchased by the player to the central computer (or  
02 alternatively to a credit computer) from a credit  
03 terminal, along with a unique code which identifies  
04 the player, the code being associated with the  
05 credit. These are preferably stored at the central or  
06 credit computer but can be stored at a higher level  
07 computer or in some cases in another control computer  
08 in a network to be described later. The player code  
09 is also marked or magnetically encoded on the credit  
10 card which is given to the player.

11 The player then inserts his credit card  
12 into a credit card reader of any of the video game  
13 machines connected to the system. The card reader  
14 reads the card, transmits the player code to the  
15 central or credit computer and obtains an indication  
16 that the player has credit. If the player has credit,  
17 the video game machine is turned on enabling the  
18 player to play, and at the same time the credit value  
19 at the central computer or credit computer is  
20 decremented by one game or the value of one game. At  
21 the same time the central computer stores the player's  
22 code number associated with a memory allocation for  
23 his score. Alternatively, the score can be stored  
24 associated with the already stored player code number.

25 The player plays the video game. At the  
26 end of the game, the score is transmitted to the  
27 central computer, and is stored. Alternatively, the  
28 game can be polled and a continuously updated score  
29 transmitted to the central computer.

30 When the video game is first turned on, it  
31 transmits to the central computer, preferably upon  
32 polling, a game drop number which identifies the data  
33 link drop. The operator then keys in a number  
34 identifying the kind of game into a keyboard  
35 associated with the interface. The central computer  
36 stores the game type number with the drop number on a  
37 disk. Alternatively, the game number is entered into

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01 the computer at the computer by the operator.

02 Preferably the computer then downloads a  
03 menu which is displayed on the game screen, giving the  
04 player several options, such as playing in the  
05 tournament, playing a practice game, selecting play of  
06 a different game, etc. The player can select the game  
07 by using the keypad.

08 The central computer preferably has  
09 previously stored a difficulty handicap associated  
10 with each kind of game. If the player had previously  
11 played that or some other kind of game, the central  
12 computer will have stored difficulty handicaps  
13 relating to the different kinds of video games which  
14 he might have played. The central computer can also  
15 keep track of an individual player's scores associated  
16 with any of the games, allocating handicaps as his  
17 skill increases by associating and storing all or some  
18 of the game number, game handicap, player numbers,  
19 previous player's previously achieved handicap and  
20 present score.

21 Since the player has been identified by  
22 number, and his number is transmitted to the central  
23 computer, with the game identification number, the  
24 player and the game are uniquely identified in  
25 association with the achieved score. Consequently,  
26 except in the unlikely case of theft of the credit  
27 card, or collusion between players, it is highly  
28 certain that the person assumed to be playing the game  
29 is actually playing the game.

30 In addition, the above system facilitates  
31 the inclusion of players in isolated locations such as  
32 those who might play a single video game located in a  
33 country store remote from an urban area, or in a  
34 person's home, of various kinds of games with the  
35 skill levels of the various games being different, all  
36 playable in a single tournament with players having  
37 various degrees of skill. Such a system thus

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01 increases the democratization of such tournaments, and  
 02 assuming that a handicap system is pre-established,  
 03 allows persons across the world to play tournaments  
 04 with each other with games of their choice. Further,  
 05 the interface facilitates automatically changing the  
 06 kinds of games, use of the game as a terminal such as  
 07 a data entry terminal, an electronic lottery terminal,  
 08 etc.

09 In the smallest system, with a small  
 10 number of video games, only a single central computer  
 11 is required. However where the numbers of games  
 12 increase, many central computers are used, each  
 13 connected via a local area network or other data  
 14 links, to a plurality of video games, and each being  
 15 connected to a further hierarchy of central computers,  
 16 which themselves can be connected to a further  
 17 hierarchy of central computers, depending on the  
 18 desired size of the network.

19 The highest tier is constituted by a  
 20 single computer or a group of computers, in which the  
 21 best scores are compared. Data messages are sent from  
 22 any of the central computers to lower ranks of  
 23 computers or to the video games themselves,  
 24 constituting announcements of winners, of future  
 25 tournaments, advertisements or other displays.

26 A preferred embodiment of the invention is  
 27 an electronic tournament system comprising a plurality  
 28 of games of skill including apparatus for generating  
 29 signals representative of the scores resulting from  
 30 the games, apparatus for displaying the scores locally  
 31 at the games, computer apparatus for storing player  
 32 identification data signals and player game credit  
 33 signals associated with selected player identification  
 34 data signals, a player identifier reader associated  
 35 with each of the games for receiving a player  
 36 identifier, reading the identifier, forwarding a  
 37 credit enquiry signal associated with the signal  
 38

LOCAL  
 DISPLAY OF  
 SCORES AT  
 GAMES

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01 identifying the player resulting from reading the  
02 identifier to the latter computer, for receiving a  
03 credit verification or denial signal from the latter  
04 computer and for enabling operation of the game in the  
05 event of receiving the credit verification signal.  
06 apparatus for transmitting the score signals to the  
07 central computers, whereat the scores can be compared  
08 and a winning score can be computed, apparatus at the  
09 games for receiving signals from the computer  
10 representative of the winning score resulting from the  
11 scores and/or announcement displays, and apparatus for  
12 displaying the winning score and/or announcement  
13 displays at all the games.

DISPLAY  
WINNER AT  
ALL GAMES  
ORDERING?

14 More generally, another embodiment of the  
15 invention is an electronic tournament system  
16 comprising a plurality of games of skill including  
17 apparatus for generating signals representative of  
18 scores resulting from the games, apparatus for  
19 displaying the scores locally at the games, apparatus  
20 for transmitting the score signals to a central  
21 computer, whereat the scores can be compared and a  
22 winning score can be computed, apparatus at the games  
23 for receiving signals from the computer representative  
24 of the winning score resulting from the scores and/or  
25 announcement displays, apparatus for displaying the  
26 winning score, and/or announcement displays, at all of  
27 said games.

28 Another embodiment of the invention is a  
29 tournament system comprising a plurality of games, a  
30 central computer linked to the games for receiving  
31 scores achieved on the games by a player, apparatus  
32 for storing a handicap value relating to players of  
33 the games at the central computer, apparatus at the  
34 games for transmitting a player identification signal  
35 to the computer, whereby scores achieved on the games  
36 can be modified at the central computer by the  
37 handicap value associated with the player playing the



01 games to produce a resultant score.

02 Another embodiment of the invention is a  
03 tournament system comprising a plurality of games of  
04 different kinds, apparatus for storing a handicap  
05 value relating to the kind of game relative to other  
06 ones of the games at either of the games or the  
07 central computer, a central computer linked to the  
08 games for receiving scores achieved on the games,  
09 whereby scores achieved on the games can be determined  
10 and modified by the handicap value associated with  
11 each of the games.

12 Another embodiment of the invention is a  
13 tournament system comprising an electronic game  
14 including an internal memory for storing at least  
15 score data signals relating to scores achieved on the  
16 game, at predetermined memory locations, a data link-  
17 to a central computer, apparatus for reading the score  
18 data stored at the predetermined memory locations, and  
19 apparatus for transmitting the score data to the data  
20 link for transmission to the central computer.

21 Another embodiment of the invention is an  
22 electronic tournament system comprising a plurality of  
23 electronic games each including game processor  
24 apparatus, a game data bus, a game address bus, and a  
25 game memory for storing score data appearing on the  
26 data bus at addresses specified by data appearing on  
27 the address bus, an interface circuit associated with  
28 each game comprising interface memory apparatus having  
29 address and data ports, an interface address bus  
30 connected between the address port and the game  
31 address bus, an interface data bus connected between  
32 the data port and the game data bus, whereby data  
33 stored in the game memory can be similarly stored in  
34 the interface memory apparatus, a communication port,  
35 apparatus for reading the data stored in the game  
36 memory to obtain score data and for transmitting the  
37 score data to the communication port, a central

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01 processor, and a central computer including apparatus  
02 for communication with the interface circuits via the  
03 communication port, for transmitting polling signals  
04 to the interface circuit and thereby initiating the  
05 transmission of score data for reception to the  
06 central computer.

07 Another embodiment of the invention is an  
08 electronic tournament system comprising a plurality of  
09 central computers, a plurality of games of skill each  
10 including apparatus for generating signals  
11 representative of scores resulting from the games and  
12 for displaying the scores on a display, each game  
13 including apparatus for transmitting the score signals  
14 to one of the central computers, whereby groups of the  
15 games are associated with each central computer, the  
16 central computers being adapted to determine winning  
17 scores from each group of games, and apparatus at each  
18 of the games for receiving signals from the central  
19 computers associated therewith representative of  
20 winning score announcements for display thereof on  
21 local displays.

22 These and other embodiments will be  
23 described, and a better understanding of the invention  
24 will be obtained by reference to the detailed  
25 description below, in conjunction with the following  
26 drawings, in which:

27 - Figure 1 is a block diagram of a basic  
28 tournament system according to the invention.

29 Figure 2 is a block diagram of a large  
30 tournament system according to the invention.

31 Figure 3 is a block diagram of the video  
32 game interface according to the preferred embodiment  
33 of the invention.

34 Turning first to Figure 1, a plurality of  
35 video games such as those which include game displays  
36 2 are located relatively close to each other, e.g. in  
37 a single building. A special interface 3 as will be  
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01 described below connects the video games 1 to a data  
02 link, e.g. a local area network 4. Associated with  
03 each interface 3 is a card reader 5, preferably a  
04 magnetic stripe card reader.

05 A central computer 6 interfaces with the  
06 local area network 4, and thus can communicate with  
07 each interface 3.

08 The system can be as basic as that just  
09 described or can include one or more remote video  
10 games 7 each preferably having a game display 8. In  
11 this case the same interface 3 as previously described  
12 is connected to video game 7, but rather than being  
13 connected to local area network 4, the interfaces are  
14 connected through MODEMS 9 to telephone lines or other  
15 long data links such as time or frequency shared CATV  
16 cable 10. The central computer 6 is connected to the  
17 data link, i.e. telephone line or CATV cable via its  
18 own MODEM, via a two-way videotext channel for  
19 example.

20 In addition, a remote terminal 11, having  
21 a keyboard 12 connected thereto is connected to the  
22 central computer 6. The terminal 11 can be one merely  
23 having limited memory, utilizing memory of the central  
24 computer 6, or can be a so-called smart terminal,  
25 containing its own substantial memory and processing  
26 power. Alternatively in some instances it may be  
27 desirable to have the terminal 11 with keyboard 12  
28 connected to the central computer by telephone line,  
29 CATV cable or other data link.

30 The tournament system operates as  
31 follows. Persons wishing to take part in the  
32 tournament purchase credits from an attendant who  
33 operates terminal 11. The attendant assigns a  
34 different number to each participant, and encodes a  
35 magnetic stripe on a credit card with the assigned  
36 number, by means of a card encoder 13, and gives the  
37 card having the assigned numbers to each participant.

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01 The attendant enters the numbers into terminal 11 via  
02 keyboard 12 as well as the amount of credit. It  
03 should be noted that the amount of credit for each  
04 participant need not be identical, and can be either  
05 an actual money value or can be specific games units,  
06 depending on how it is desired to set up the system.  
07 Use of actual money value can facilitate the players  
08 playing games having different playing cost values.  
09 In the case of game units, this assumes that each of  
10 the games has the same or a multiple thereof playing  
11 value. In the case of use of money credit in  
12 particular, this also facilitates assigning different  
13 game cost, the higher in the tournament the player may  
14 be playing, i.e. which can coincide with prize value,  
15 etc.

16 Some of the players may already have had  
17 numbers assigned from previous tournaments, and may  
18 already have some credits remaining. In this case the  
19 attendant need merely key in the player's number into  
20 keyboard 12 with whatever the player would like to add  
21 to his previous credits.

22 Assuming that the terminal 11 is a  
23 so-called "dumb" terminal, without having substantial  
24 storage ability, the player numbers and credit values  
25 are transmitted from keyboard 12 via terminal 11 to  
26 central computer 6 for storage. Central computer 6  
27 stores the credits associated with the player numbers  
28 in a local memory, preferably a hard disc drive 6A.  
29 Alternatively, the system can be set up whereby  
30 terminal 11 itself stores the player number and credit  
31 values. The present description will however be  
32 directed to the case in which the central computer 6  
33 stores the just-described data, but it will become  
34 clear to a person skilled in the art how the system  
35 will operate with storage at terminal 11.

36 The players now disperse to the various  
37 video games, which can be those connected to the local  
38

01 area network 4, and indeed could be located at various  
02 places in the city or country accessible by telephone  
03 line, for example, to telephone computer 6. It should  
04 be noted that since telephone lines are accessible  
05 virtually anywhere in the world, a game can be  
06 connected to central computer 6 from virtually any  
07 location. Therefore a person can play in the local  
08 tournament from virtually anywhere in the world. It  
09 should also be noted that all players of the  
10 tournament need not play the games simultaneously.

11 The players enter their credit cards into  
12 card readers 5. Alternatively, password codes can be  
13 entered on interface keyboards. This activates  
14 interfaces 3 which, in the case of being connected to  
15 local area network 4, each applies a player credit  
16 enquiry signal with the player number, and the local  
17 video game identification number, to central computer  
18 6 via local area network 4, which usually operates in  
19 a well known manner transmitting packets of data.

20 In the case of each remote video game,  
21 interface 3 activates MODEM 9, automatically dialling  
22 central computer 6 over the telephone line, gaining  
23 access to a bidirectional port associated with the  
24 central computer therein. In the case of a CATV  
25 cable, the equivalent can be done by data packet  
26 channel acquisition, for example.

27 Central computer 6 receiving data packets  
28 from each of the interfaces containing at least video  
29 game numeric drop identification data (i.e. address)  
30 and player number data searches its memory for the  
31 player codes and associated credit data. Assuming  
32 that it finds sufficient game credits associated with  
33 the value of the game which is to be played by a  
34 particular player, it decrements the stored credit  
35 data associated with the specific stored player  
36 identification code and sends a "game start" signal  
37 addressed to the video game address identified by the  
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01 video game code previously sent to the central  
02 computer. The addressed video game, detecting the  
03 address at interface 3, receives the "game start"  
04 signal, and applies a signal to the associated video  
05 game 1 to initiate the game start sequence. The  
06 display 2 displays the beginning of the game.

07 It should be noted that the central  
08 computer 6 can send messages in addition to "game  
09 start" message to the video games. For example in the  
10 case of a tournament it can transmit data signals to  
11 each of the video games to display an announcement,  
12 for example, the participation of the immediately  
13 following game in a specific tournament. The central  
14 computer can also read a menu or other similar display  
15 allowing the player to select a function by pushing a  
16 key on the interface keyboard. Since the messages are  
17 sent individually to the various video games, there is  
18 no need for each of the games to start  
19 simultaneously although they can be started  
20 simultaneously if desired. Thus it can be  
21 predetermined that, for example, all games which are  
22 accessed via credit card within the morning of a  
23 particular day would participate in the tournament.  
24 Each time a game is to be started on any of the video  
25 and displayed on display 2. Yet players not wishing to  
26 participate in the tournament can utilize the video  
27 games using coin start (for those games having a coin  
28 start facility), which will not initiate activation of  
29 the central computer. In the case of a game having a  
30 coin start, the coin switches can be monitored by the  
31 interface whereby a debit card player can add to his  
32 credits by inserting coins into the game coin slots.

33 It should also be noted that with various  
34 systems such as just described located at various  
35 places across the country (or indeed across the  
36 world), a single tournament can be played in various  
37 time zones at different times. What is necessary is

01 that the local central computer 6 should recognize  
02 that the score data relates to a particular  
03 tournament, and if desired, download announcement  
04 messages.

05 Now assuming that the video games have  
06 been started, at different times, by means of  
07 recognition of the player identification card, the  
08 player plays the game. The score data is stored in  
09 interface 3 as it increments. At the end of the game  
10 the final score is stored in interface 3 along with  
11 data which indicates the end of the game (referred to  
12 herein as "game over" code), which exactly mirrors the  
13 similar score and normally stored in video game 1.  
14 Central computer 6 continuously polls the interfaces 3  
15 and eventually detects the "game over" code with the  
16 associated score. This score is received by central  
17 computer 6 and is stored associated with the player  
18 code (which may be modified by his personal handicap  
19 and/or the game handicap).

20 At the end of the time of the tournament  
21 the attendant keys a "tournament over" code into  
22 keyboard 12, which is transmitted via terminal 11 into  
23 computer 6. Alternatively the central computer can  
24 cause each game to utilize an internal software timer  
25 to determine the end of each game, (or if desired,  
26 could count games played and determine the end of the  
27 tournament based on the number played). The central  
28 computer sorts the scores identifying the player  
29 number (and player name if previously stored with the  
30 code), and determines the winner. Central computer 6  
31 then initiates transmission of a winner announcement  
32 signal to each of the video games. The interface  
33 circuit at each of the vide games stores the  
34 announcement signal for display on the video game as  
35 soon as the associated game becomes idle. The  
36 announcement signal can include, for example, the name  
37 or player identification code of the player who has

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—  
INCREMENTAL  
SCORE IS  
STORED

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01 won, and other associated announcements, such as the  
02 rank of the tournament, the game which was played, the  
03 date and time of the next tournament, point or prize  
04 value, instructions as to how prizes are to be  
05 awarded, any advertising, or the like. Such  
06 announcements can be repeated for predetermined  
07 periods of time, whenever the local video games become  
08 idle. Indeed, it will be seen that the present  
09 invention facilitates cutting off operation of the  
10 game, and substituting a display downloaded from the  
11 central computer.

12 It is important to recognize that the  
13 video games 1 (which will be considered below to  
14 include an associated display 2 if it utilizes such  
15 display) need not be identical. Since each kind of  
16 the video games is identifiable by means of a code,  
17 central computer 6 (or other computer in the network  
18 to be described below) can store an indicator of what  
19 each video game actually is, both specifically, and in  
20 terms of handicap value. Indeed, a regional or  
21 national computer (to be described later with  
22 reference to Figure 2) could store and download the  
23 handicap values to the central computer 6. The  
24 handicap values can be associated both with the play  
25 difficulty of the video game relative to other kinds  
26 of games, and of the play level of difficulty as  
27 between similar games, and can be varied with  
28 experience of scores achieved on a particular kind of  
29 game in particular localities. Thus when a score is  
30 received at central computer 6, it can be modified in  
31 any one or more of three ways, the first by the kind  
32 of game, the second by play difficulty of that kind of  
33 game, and the third by the handicap previously  
34 assigned to the player. Since both the player number  
35 and his previous handicap level and also the  
36 above-described factors associated with each game are  
37 stored at the central computer, the central computer  
38 can automatically assign an equivalent score value  
39 different from the actual score received for each game  
40 played by each specific player. This facilitates



01 players of widely differing abilities to play on  
02 various kinds of video games in a single tournament  
03 with an approximate equal degree of fairness.  
04 Further, since participants in the tournament are  
05 identified by means of the debit cards inserted in the  
06 card readers or password code keyed into the  
07 interface, only those players who have requested to be  
08 entered in the tournament and have prepaid for their  
09 games are actually counted in the tournament while  
10 video games operated only by coin insertion are not  
11 counted in the tournament. Alternatively, a player  
12 identified by a debit card or password code can add to  
13 his credits by inserting coins into the game coin  
14 slots. Further, since each player in the tournament  
15 has been allocated a number which is individual to  
16 him, and, preferably, his name has been entered into  
17 the central computer 6 as well by the attendant, that  
18 player entering his card into the video game of his  
19 choice to enter the tournament raises the certainty  
20 level to a very high degree that the actual player  
21 playing the tournament is the one which is assumed to  
22 be playing. All the games of the tournament clearly  
23 need not be played simultaneously. Since the scores  
24 are incremented automatically by the game, the entry  
25 of fraudulent scores is substantially avoided.

26 The system shown in Figure 1 is usefully  
27 deployed where the data link or local area network  
28 connect to video games at a central location, such as  
29 in an arcade, with the remote video games 7 connected  
30 to that arcade via local telephone lines or a CATV  
31 cable. Figure 2 depicts a block diagram of another  
32 embodiment of the tournament system in which a  
33 plurality of such local systems are interconnected  
34 into a national or international system. As shown in  
35 Figure 2, a plurality of central computers 6 each have  
36 a plurality of video games 1 connected thereto as  
37 described with reference to Figure 1 (the interface  
38

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01 circuits being present but are not shown in Figure 2  
02 for the sake of clarity. Groups of local central  
03 computers 6 are connected via a data network 6A to  
04 regional computers 13. Connection of the central  
05 computers 6 with the regional computers 13 can be by  
06 means of a data network such as TYMNET, DATAPAC, or  
07 some other X.25 or other protocol packet switching  
08 network or the like which can transmit bidirectionally  
09 between computers.

10 Groups of regional computers 13 are  
11 connected via a packet switched network 13A to  
12 national computer 14. In this way hierarchies of  
13 computers access higher and lower level groups of  
14 computers to set up national tournament networks.  
15 Indeed, national tournament networks can be connected  
16 via a similar type of network 14A to a single  
17 international computer 15 to facilitate international  
18 tournaments.

19 In operation, the regional computers 13  
20 poll the local central computers 6 for best score  
21 (modified by handicaps, etc. as noted earlier) and  
22 associated player identification data. The national  
23 computer 14 polls the regional computers 13 for  
24 similar data, while in the case of an international  
25 tournament the international computer 15 polls the  
26 national computers 14 for the similar data. Such  
27 hierarchies of computers can be similar to those which  
28 presently exist for storage and transmission of  
29 electronic mail such as the MCI electronic mail  
30 network.

31 The international, national, and regional  
32 computers also initiate and download regional,  
33 national or international notices for eventual  
34 transmission to the local video games.

35 As an example of operation, tournaments  
36 could be held over a period of days, weeks or months  
37 at the local central computer level at hundreds or  
38 thousands of locations across the country or the

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01 world. By this means players are handicapped, the  
02 resulting handicap data being stored preferably in the  
03 central computers 6. At a later time, regional  
04 tournaments would be held whereby those wishing to  
05 participate play on their local video games, but this  
06 time the central computers 6 are polled by means of  
07 the regional computers 13. While the player numbers,  
08 handicaps and high scores are retained at the central  
09 computer level 6, each of the central computers 6 is  
10 polled by the associated regional computer, which  
11 calculates by means of comparison of handicap scores  
12 modified by the game skill level, which player number,  
13 at which specific game, is declared the winner.  
14 Preformatted messages, in which the player numbers and  
15 names, arcade or central computer identification etc.  
16 are inserted are automatically downloaded from central  
17 computer 13 to central computers 6 for downloading to  
18 video games 1, are either initiated at a particular  
19 time, or are manually initiated, thereby facilitating  
20 identification, and declaration by means of a  
21 broadcast to all video games in the local area that a  
22 local winner has been determined. Such a tournament  
23 might be citywide, for example.

24 By a similar technique the national  
25 computer 14 polls the scores, player identification  
26 numbers, etc. from the regional computers 13 in the  
27 case of a national tournament. In the case of an  
28 international tournament, the national computers 14  
29 are polled from the international computer. Of course  
30 the time established for declaration of a winner must  
31 be determined keeping the time zone and convenient  
32 time of play in mind, which is particularly important  
33 in the case of international tournaments.

34 However the above system clearly  
35 facilitates universal access to a tournament by  
36 players of varying skill, on different kinds of games,  
37 located in widely different locations, which can be  
38

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01 either associated with local video game arcades or  
02 located remotely from the local arcades and are  
03 connected thereto by telephone line.

04 The above system is facilitated by the use  
05 of a universal interface for the video games, a block  
06 diagram of which is shown in Figure 3. As was  
07 mentioned earlier, such an interface is possible since  
08 it is found that video games (the definition of which  
09 is deemed to include electronically operated pinball  
10 machines or other games which transmit their data via  
11 internal buses) contain three general kinds of  
12 internal parallel buses: an address and control bus  
13 16, a data bus 17, and a start line 18. A pulse on  
14 the start line 18 normally initiates operation of the  
15 machine. Normally in such machines this pulse is  
16 generated upon the machine coin acceptor recognizing  
17 receipt of the appropriate value of deposited coins,  
18 or upon initiation by a reset button if free games are  
19 to be allocated or by a service man.

20 The address and control bus carries data  
21 common to microprocessor-memory operated apparatus,  
22 such as address information as to where data is to be  
23 stored in the memory. The data bus carries data to be  
24 stored in a local memory such as score signals, etc.  
25 These main buses 16, 17 and 18 as well as the video  
26 control bus for games which utilize a video display  
27 are accessed by the interface via one or more  
28 multi-pin connectors.

29 It has been found that each such game  
30 stores its score and other data in a local random  
31 access memory in similar locations as other games of  
32 the same model, to facilitate mass production of such  
33 games. A map of the memory is obtained either by  
34 decoding the memory or by obtaining information as to  
35 the storage locations from the game manufacturer. An  
36 overlay of the game data storage locations is stored  
37 in a random access memory (RAM) 26A of the present  
38

01 invention. In other words, data is stored in RAM 26A  
02 as to the meaning of the data stored at particular  
03 memory locations in the video game memory. As an  
04 example, data may be stored in RAM 26A indicating that  
05 at address 1000 in the local video game, storage of a  
06 "1" means that a game has begun. Other memory  
07 locations in RAM 26A indicate that score data is  
08 stored in the game memory at particular locations.  
09 The storage of this kind of information for each type  
10 of game is important to the operation of this  
11 interface. For example, for a national or  
12 international tournament, there could be hundreds or  
13 thousands of the same kind of game, and consequently  
14 as long as those games store information in the same  
15 internal memory locations, the same information for  
16 each associated interface can be stored in RAM 26A.

17 Indeed, when configuring the interfaces  
18 associated with each arcade or group of video games  
19 associated with a single central computer at the time  
20 of power-up, the information to be stored in RAM 26A  
21 can be downloaded from the central computer into RAM  
22 26A. In this way the interfaces can be moved from  
23 game to game as desired, and on powering up when the  
24 arcade opens, or at other intervals, the specific game  
25 information associated with particular games can be  
26 easily allocated to the associated proper games from  
27 the central computer. Alternatively RAM 26A can be  
28 formed of firmware, and plugged into the interface.

29 The address ports of one or a plurality of  
30 random access memories 20 are connected to the address  
31 and control bus through bus switches 21. The game  
32 data bus 17 is connected to the data ports of the  
33 random access memory 20 via bidirectional driver 22.  
34 Thus it may be seen that with switches 21 connecting  
35 the address ports of RAM 20 to address bus 16, the  
36 game data is stored in RAM 20 at the addresses  
37 specified by normal operation of the video game. Thus

01 RAM 20 stores continuously updated data exactly  
02 mirroring the data stored in the local memory of the  
03 video game to which the interface is connected.  
04

05 Switch 21 can alternatively connect the  
06 address lines portion of the main bus 23 of the  
07 interface to the address ports of RAM 20. In that  
08 case, however, a write enable input from the address  
09 and control bus 16 is lost, and the data stored at the  
10 address memory locations in RAM 20 are read out via a  
11 tri-state transceiver 24 to the data lines portion of  
12 bus 23. Thus signals received by the address inputs  
13 of RAM 20 from bus 23, without its write enable input  
14 enabled, specify which memory locations are to be read  
15 out to bus 23 via transceiver 24.

16 The data appearing on address and control  
17 bus 16 also includes signals relating to confirmation  
18 of the start of the game, which can be used to define  
19 the end of the game (i.e. that the count of "men" or  
20 tries has been decremented to zero) signals, and other  
21 such supervisory and controlling information. Forms  
22 of these signals are loaded under control of RAM  
23 controller 25 from RAMs 26, where the signal form was  
24 previously stored, through peripheral interface  
25 adapter 27, into digital comparators 28. The other  
26 inputs of comparators 28 are connected to address and  
27 control bus 16. Therefore the comparators 28  
28 continuously compare and thus monitor the form of the  
29 data appearing on the address and control bus 16 to  
30 find a match for such signals as "end of game". As  
31 soon as the match is found in the comparators, the  $\overline{CE}$   
32 leads of comparators 28 go to low level, and being  
33 connected to corresponding inputs of a NAND gate 29,  
34 cause an output signal to be applied to a tri-state  
35 transceiver 30, which generates an interrupt signal to  
36 a microprocessor 31. In this manner signals such as  
37 "end of game" can cause the microprocessor 31 to  
38 initiate a software routine which enables switch 21 to  
39

01 switch, and thus to carry signals from bus 23 which  
02 are address data for reading the data stored in RAM  
03 20. The locations are stored in RAM 26A which are  
04 output under control of microprocessor 31. The result  
05 is the placing of the score data onto bus 23. The  
06 score data can then be stored in a different portion  
07 of RAM 26A.

08 A keypad 32 and a magnetic card reader 33  
09 are connected to inputs of peripheral interface  
10 adapter 34. An array of DIP switches 35 is connected  
11 to peripheral interface adapter 27. If the coin  
12 switches of the game are to be monitored, lines  
13 connected to them are connected to inputs of  
14 peripheral interface adapter 34.

15 The microprocessor 31 is connected to bus  
16 23 via a buffer 36. Also connected to bus 23 is a  
17 read only memory 37 containing firmware for bootstrap  
18 starting the operation of the microprocessor, address  
19 decoder 38, and interface to the data link to the  
20 central computer. Assuming that the local area  
21 network referred to earlier is ETHERNET standard, the  
22 data link interface will be comprised of a direct  
23 memory access 39, and ETHERNET controller 40, and a  
24 Manchester coder-decoder 41 connected to the ETHERNET  
25 controller, and to a local area network cable 42.  
26 However ETHERNET need not be used; any suitable data  
27 link can be used, such as a multidrop line or one  
28 conforming to the standard RS485.

29 In case ETHERNET is used, operation of the  
30 ETHERNET controller 40 and Manchester decoder 41  
31 between cable 42 and bus 23 is well known, and  
32 information relating thereto can be obtained from  
33 Xerox Corporation. The ETHERNET controller can be  
34 part number 8003, and the Manchester coder-decoder can  
35 be part number 8002. Operation of the microprocessor  
36 31, buffer 36, boot ROM 37, direct memory access 39,  
37 RAM 26A, address decoder 38, means for creating  
38

01 interrupts to microprocessor 31, RAM controller 25 and  
02 random accessor memory 26 as a system is also known to  
03 persons skilled in the art and an explanation thereof  
04 can be obtained from the book MICROCOMPUTER PRIMER by  
05 Mitchell Waite and Michael Pardee, available from  
06 Howard W. Sams & Co. Inc. The magnetic card reader  
07 may be obtained from Omron Corp. A successful  
08 prototype of this invention was made using type 68309  
09 for microprocessor 31, type 244 for buffer 36, type  
10 2716 for boot ROM, type 245 for tri-state transceiver  
11 30, types 138 and 139 for address decoders, type 4500  
12 for dynamic RAM controller 25, and type 4416 for  
13 dynamic RAMs 26A and 26B. RAMs 26A and 26B can be  
14 combined into one RAM.

15 The description of operation herein will  
16 thus constitute an algorithm in descriptive form from  
17 which the software by which microprocessor 31 can  
18 control the circuit can be designed. Since software  
19 can take many forms depending on the microprocessor  
20 which is used, it is believed most helpful to a person  
21 skilled in the art understanding this invention to  
22 describe the operation from which the flow chart as  
23 well as the associated code can be written.

24 The system described above is connected  
25 via the data link to a central computer 6 as described  
26 earlier.

27 It will be assumed that the central  
28 computer 6 is waiting for the various video games  
29 initially to turn on. Assuming that a video game has  
30 been powered up, either simultaneously or later the  
31 subject interface circuit is powered up.

32 The bootstrap firmware stored in ROM 37  
33 now causes the microprocessor 31 to interrogate RAM  
34 26A to obtain the values of DIP switches 35 and the  
35 keypad 32 which are connected via the peripheral  
36 interface adapters 27 and 34 respectively from bus  
37 23. The DIP switches 35 are previously set to  
38 identify uniquely the associated video game, and can  
39



01 be of the form of an eight digit binary code, which is  
 02 locally stored in RAM 26A. The operator then will key  
 03 a code into keypad 32 (or can key the code in at the  
 04 central computer 6) which identifies the form of the  
 05 game, e.g. representing "PACMAN", "SARGON II" etc. This  
 06 code should be common for similar kinds of games  
 07 throughout the local system, and preferably should  
 08 also be common throughout the system.

09 The unique game and "kind of game" data  
 10 are transmitted via the peripheral interface adapters  
 11 to the bus 23 from which they are transmitted to the  
 12 central computer 6 after storage in RAM 26A, upon  
 13 polling from the central computer as described below.

14 Initially the corresponding DIP switch  
 15 code values are stored on a floppy or hard disc store  
 16 6A at the central computer 6 (Fig. 1), which  
 17 identifies each of the games. These codes are used as  
 18 addresses from the central computer to facilitate  
 19 sequential polling each of the interfaces via the  
 20 data link network. The code value of the DIP switches  
 21 is applied from the DIP switches to the peripheral  
 22 interface adapter 27, and is stored in a RAM 26A.  
 23 Upon polling from the central computer, the stored  
 24 DIP switch value is compared with the address sent  
 25 from the central computer by software control in the  
 26 microprocessor 31. An indication is generated as a  
 27 result and transmitted to the central computer upon  
 28 polling by the local central computer, indicating that  
 29 the local interface has been powered up.

30 As noted earlier, the operator then keys  
 31 in upon keypad 32 a code identifying the kind of game,  
 32 which is unique to all of the same games connected to  
 33 the local area network, or preferably, in the  
 34 tournament. This code is passed through peripheral  
 35 interface adapter 34 and is stored in digital  
 36 comparator 43. As the local interface is polled, the  
 37 data as to the kind of game is keyed in is transmitted  
 38

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01 to bus 23 and through the local area network via data  
02 link 42 to the central computer. Therefore the  
03 central computer is enabled to store the "kind of  
04 game" information associated with the number which  
05 identifies the game. The above is important in the  
06 case in which the kind of game which is provided in  
07 the video game is able to be changed from the central  
08 computer. According to a further embodiment, the  
09 program as to the kind of game to be played can be  
10 downloaded from the central computer 6 for  
11 transmission to an addressed interface in order to  
12 change the kind of game which is played, or the  
13 difficulty of the resident game (i.e. its speed,  
14 etc.).

15 Alternatively the "kind of game" code can  
16 be entered at the central computer 6.

17 With receipt of the kind of game code and  
18 numeric identification of the interface (which  
19 constitutes a local interface address designation),  
20 according to one embodiment of the invention the  
21 central computer now transmits data to the local  
22 interface for storage in RAM 26A, relating to the  
23 memory 20 address locations for the scores and other  
24 data received from the game relating to the kind of  
25 game which was identified. It should be noted that  
26 such data can be downloaded from the central computer  
27 via the local area network for storage in RAM 26A, or  
28 alternatively, RAM 26A could be constituted by  
29 firmware which contains the required data or indeed  
30 can be downloaded from a local memory transfer device  
31 which can be locally connected to bus 23 for entering  
32 data into RAM 26A.

33 The local interface circuit has now been  
34 initialized and is ready for play. As described  
35 earlier, a player obtains a credit card with his  
36 unique number recorded on it from an attendant, who  
37 has stored game credits associated with each player  
38

01 number in central computer 6. This player now  
02 introduces his card into the magnetic card reader 33,  
03 which reads his player number, passes it through  
04 peripheral interface adapter 34 into digital  
05 comparator 43, which applies the data via selector 44  
06 to data bus 23. This data is stored in RAM 26A, and  
07 is read out to central computer 6 via data link, e.g.  
08 via the ETHERNET controller, decoder/encoder 41 and  
09 cable 42, to central computer 6.

10 At central computer 6 a check is made for  
11 the existence of the player code and of the existence  
12 of credits. If both exist, the credit is decremented  
13 by the value of one game, and a "start" signal is  
14 returned via the local area network to bus 23, from  
15 which it is stored in RAM 26A. The signal is passed  
16 via RAM 26 to the peripheral interface adapter 34  
17 which applies a credit pulse to credit pulse lead 18.  
18 The pulse applied is of the form which is generated in  
19 the video game machine when a coin start is  
20 initiated. The game is now started under control of  
21 the software resident in the video game.

22 Data now applied to bus 23 under control  
23 of microprocessor 31 is carried by lead 46 to the  
24 control input of switch 21 and causes switch 21 to  
25 connect address and control bus 16 to the address  
26 inputs of RAM 20. The address and control data which  
27 appears on the address and control bus of the video  
28 game passes through switch 21 to the address ports of  
29 RAM 20, thus causing data which is presented to RAM 20  
30 to be stored at the designated address locations.

31 The score and display data signals appear  
32 on the data bus 17 of the video game and are thus  
33 transmitted via bidirectional driver 22 into the  
34 address locations in RAM 20 specified by the addresses  
35 received on the address and control bus 16. The  
36 bidirectional driver 22 is enabled to transmit the  
37 data signals for storage in RAM 20 via signals

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01 controlled by microprocessor 31 placed on the bus 23  
02 carried by lead 46A. Thus as the game continues, all  
03 of the score data is continuously stored and updated  
04 in RAM 20. It will be recalled that the storage  
05 locations in RAM 20 of the score and other data have  
06 previously been stored in RAM 26A.

07 When the game has been completed, a code  
08 signal or signals identifying the end of the game  
09 appears on the address and control bus 16 from the  
10 video game. This can be for example the decremented  
11 value of game "men" or attempts, or the like. This  
12 signal is identified in comparators 28, which had  
13 stored therein the predetermined code signals  
14 designating "end of game" which were initially  
15 downloaded into RAM 26A. As described earlier, this  
16 causes a "match" signal to be applied to NAND gate 29,  
17 which generates an interrupt signal to microprocessor  
18 31, upon passing through tristate transceiver 30. At  
19 this point under control of microprocessor 31 a signal  
20 is applied to switches 21 via bus 23 and lead 46 to  
21 switch switches 21 in order to allow RAM 20 to receive  
22 address signals from bus 23 instead of from bus 16.  
23 The data now applied to bus 23 under control of  
24 microprocessor 31 relates both to the addresses of the  
25 data to be read from RAM 20 (i.e. the total score  
26 value) obtained from the memory overlay data stored in  
27 RAM 19, the inversion of a "write enable" signal  
28 previously applied to the  $\overline{WE}$  inputs of RAM 20, (and  
29 chip select data applied to the RAM CS inputs,  
30 assuming that RAM 20 is on more than one chip).

31 As a result, the data stored at the  
32 predetermined score locations identified from the data  
33 stored in RAM 26A is read out of RAM 20 via tristate  
34 transceiver 24 (which is also is connected for  
35 control to bus 23), which transmits the data on bus 23  
36 for storage in RAM 26A. Upon the next polling cycle,  
37 central computer 6 accesses the score data from RAM  
38

39

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POLLING

01 26A which was read from RAM 20, which is transmitted  
02 along the data link cable 42 for storage at central  
03 computer 6.

04  
05 Once the game has ended, the local video  
06 game shuts itself off in the normal way, and displays  
07 on its screen a maintenance sequence to attract  
08 players, and is ready for the next player. The  
09 central computer, however, continuously polls all of  
10 the video games in its network, connected by data link  
11 or local area network and by telephone line, storing  
12 the scores of various players on different games  
13 associated with the player numbers read from the  
14 magnetic card reader.

15 As noted earlier, previous plays may have  
16 facilitated allocating a handicap against the player  
17 number, which would cause modification of his score.  
18 The actual score or value stored can be as varied as  
19 might be desired; the score itself can be stored,  
20 sequences of scores of various games can be stored,  
21 handicap values can be stored, tournament rank can be  
22 stored, etc. all associated with the player number and  
23 all retained in the memory of the central computer.  
24 Either the continuously updated scores, or the final  
25 score after detection of the "end of game" signal, can  
26 be accessed and stored at the central computer.

27 Automatically at a predetermined time,  
28 after a predetermined number of games played, or upon  
29 initiation by an operator, the central computer 6 (or  
30 a computer higher upon the network hierarchy which has  
31 accessed the noted data) can be initiated to perform a  
32 sort of the handicapped or actual scores, for a  
33 determination of the best score. The various  
34 techniques for establishing the winner can also be  
35 varied, depending on the rules of the tournament.  
36 Once the tournament winner has been determined,  
37 display data can be transmitted via the local area  
38 network, telephone lines, etc. into the local memory,

01 for storage and for local display on the display of  
02 the local video game, once it is free of players  
03 (idle). This is performed as follows.  
04

05 A video display generator 47, which has a  
06 random access memory 28 connected to it, is connected  
07 to bus 23. Signals for displaying on the CRT display  
08 of the video game, that is, signals for controlling  
09 the red, green, blue and SYNC leads of the video  
10 control are downloaded by the data link and video  
11 control generator 47 into RAM 28. The output of video  
12 display generator 47 is connected to a dematrix 49,  
13 which produces corresponding signals on its R, G, B,  
14 and SYNC leads. The signals are applied to one input  
15 51 of a multiplexer 50.

16 The R, G, B and SYNC control leads from  
17 the video game are connected to input 52 of  
18 multiplexer 51. The output port 53 of multiplexer 51  
19 is connected to the R, G, B and SYNC leads in the  
20 video game to which the leads connected to input 52  
21 previously were connected. In other words, R, G, B  
22 and SYNC video control leads in the video game are  
23 broken and are connected through multiplexer 50.

24 A video control lead 54 is connected from  
25 the peripheral interface adapter 27 to the control  
26 input C of multiplexer 50.

27 In operation, microprocessor 31 controls  
28 the switching of the R, G, B and SYNC inputs of  
29 multiplexer 50 between those from the game, and those  
30 from dematrix 49. When a display has been downloaded  
31 in RAM 28 from central computer 6, microprocessor 31  
32 can sense the end of the game as described earlier (or  
33 can force the end of the game) by applying a signal  
34 via bus 23 and peripheral interface adaptor 27 to  
35 apply a control signal on lead 54 to multiplexer 50,  
36 to switch so that the R, G, B and SYNC outputs of  
37 dematrix 49 pass to output port 53 instead of the R,  
38 G, B and SYNC inputs from input 52. End of game

01 signals eventually normally will appear on the bus as  
02 if a game had been left unfinished. Microprocessor 31  
03 now controls video display generator 47 which accesses  
04 the signals stored in RAM 28 to output the desired  
05 display via the desired matrix 49, its R, G, B and  
06 SYNC output leads, port 51 of multiplexer 51, output  
07 port 53 to R, G, B and SYNC inputs of the video  
08 control circuitry of the video game. The interface  
09 circuit circuit thus entirely controls the display at  
10 the game. Furthermore, the player can interact with  
11 the interface circuit by means of pushing buttons in  
12 keypad 32.

13           As an example, according to another  
14 embodiment of this invention, when a player has  
15 inserted his magnetic card into card reader 33 in  
16 order to play a game, once the player's identification  
17 code and credit has been verified, rather than  
18 generating a credit impulse on lead 18 as described  
19 earlier, the central computer can download a display  
20 to be displayed on the video game display which  
21 constitutes a menu. The menu can be, for example,  
22 questions concerning the kind of game or tournament to  
23 be played. For example the player could be requested  
24 to indicate whether the game is to be played for  
25 practise, to be played in a tournament, or whether a  
26 selection of other kinds of games should be offered.  
27 One of the offerings could be the utilization of the  
28 video game as a lottery terminal, for example.  
29 Another could be whether the video game could be used  
30 to receive or send messages. The player can select  
31 the menu choice by pressing one or more keys of keypad  
32 32, which is read by microprocessor 31 as described  
33 earlier, and which information is forwarded as data  
34 signals to the central computer 6, and which can be  
35 transmitted via the network described with respect to  
36 Figure 2 to any other computer or video game.

37           Assuming that the player selects a menu  
38

01 item by which the kind of game to be played is to be  
02 changed, he pushes a button on keypad 32 which is read  
03 and transmitted to the central computer as described  
04 earlier. The computer downloads signals to control  
05 the conversion to another game into RAM 26B. It also  
06 downloads the appropriate display signals to be  
07 displayed during the game into random access memory 23  
08 via video display generator 47.

09 A control signal is transmitted to switch  
10 21 to connect its input terminals to bus 23. The  
11 address locations in RAM 20 of the game control data  
12 are transmitted via bus 23 and switch 21 to the  
13 address inputs of RAM 20. At the same time a signal  
14 is transmitted to tristate transceiver 24 to change  
15 its direction of transmission and to bidirectional  
16 driver 22 to place it in its non-transmission mode.  
17 The data to be stored in RAM 20, the game control  
18 data, is transmitted from RAM 26B via bus 23 through  
19 tristate transceiver 24 into RAM 26B at the memory  
20 locations specified by the address signals passing  
21 through switch 21.

22 Once the special control data has been  
23 stored in RAM 20, under control of microprocessor 31  
24 switch 21 is maintained switched to obtain its control  
25 and address information again from address control bus  
26 23, under control of microprocessor 31 and address  
27 control signals stored in RAM 26B which were  
28 downloaded from central computer 6. This can merely  
29 constitute an initial address location and  
30 instructions to repeatedly increment addresses up to a  
31 predetermined address in unity steps. Driver 22 is  
32 switched to transmit data toward bus 17 by control  
33 signals received via bus 23. Consequently the address  
34 and control data from RAM 26B pass via bus 23, switch  
35 21 to the address ports of RAM 20 to cause readout of  
36 the stored data. Since bidirectional driver 22 has  
37 also been switched in its opposite transmission



01 direction, the game control data is transmitted from  
02 RAM 20 through bidirectional driver 22 to the game  
03 data bus 17.

04 The displays to be displayed on the CRT  
05 display of the video game are generated as described  
06 earlier by the use of video display generator 47, data  
07 stored in random access memory 28, and the use of  
08 dematrix 49 and multiplexer 50. The player plays the  
09 game by the use of keypad 32.

10 In the present case the interface  
11 circuitry has taken over the function of controlling  
12 the game, but utilizing the original game display. In  
13 this manner the players can be given a choice of many  
14 different kinds of games; they are not restricted to  
15 the use of the game for which the video game was  
16 originally designed. Further, the entire apparatus  
17 can be used as a local data terminal for other  
18 purposes such as sending messages, as a local lottery  
19 terminal, etc.

20 An analogous interface can be made to the  
21 game audio circuitry whereby voice synthesized or  
22 music announcements can be provided. Further, the  
23 coin switches in the coin acceptor mechanism of the  
24 video game can be monitored by means of leads 55 which  
25 are connected to peripheral interface adaptor 34. As  
26 one of the options given on the initial menu the  
27 player can be asked whether he wishes to add credits  
28 to his credit balance by means of coin insertion. If  
29 he selects the appropriate keypad 32 key, the coin  
30 switches are monitored by microprocessor 31 via  
31 peripheral interface adaptor 34 sensing switch  
32 closures.

33 An interface can also be made to a local  
34 printer, for printing point scores, receipts,  
35 statements of prizes earned, etc. A printer interface  
36 56 is connected to the bus 23, and also is connected  
37 to a printer 57. Data to be printed on printer 57 is

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01 loaded from the central computer into RAM 26A as  
02 described earlier, and under control of microprocessor  
03 31 passes through printer interface 56 to printer 57,  
04 in a manner known in the computer art.

05 In the above manner the central computer  
06 can provide display and audio signals to all of the  
07 video games associated with the tournament.  
08 Announcements can also be made of forthcoming  
09 tournaments, and the central computer can download  
10 advertising to the video games, can transmit messages  
11 to individual video games, can provide printed prize  
12 tickets, etc.

13 In addition, since the address and control  
14 bus of the video game can interact directly with RAM  
15 20, control information for operating different games  
16 can be stored in RAM 20, i.e., the specific video game  
17 can thus be changed. In this mode of operation, RAM  
18 20 takes the place of the memory in the game, and  
19 operates as described above, interacting with the  
20 display under control of the control signals on bus  
21 16. In this case the locations of RAM 20  
22 corresponding with those of the memory of the video  
23 game which store the game program are loaded by a game  
24 program from the central computer. Thus the system  
25 provides great versatility, since it can be used as an  
26 advertising vehicle, can allow various players of  
27 different skills to play different games in  
28 competition, and can vary the game which is played.  
29 Indeed, specialized games can be designed: each game  
30 terminal can be formed into an auction terminal where  
31 various "players" compete to purchase an item, and  
32 various different games of skill or the like can be  
33 used in place of the video games. Purchases or  
34 lottery payments can be deducted from the credit  
35 balance of the "player" (or terminal operator).

36 It should be noted that this system can be  
37 used to provide many other functions. Since specific  
38

01 games can be downloaded, and since the player's skill  
02 level and a handicap relating to the specific game  
03 which is chosen is already known, the specific player,  
04 identified by his player number can build up a set of  
05 scores and handicaps associated with any of the  
06 selected games, which is stored at the central  
07 computer.

08 The result of the above facilitates the  
09 establishing of a nationwide skill network by means of  
10 the arcades and local, regional and national network  
11 described above, in which the scores achieved by any  
12 player for any game can be compared with the scores of  
13 any other within the tournament. Indeed teams of  
14 players can be identified by number, their scores kept  
15 and compared, establishing a national roost.

16 Numerous variations to the above invention  
17 may now become evident. For example instead of a  
18 magnetic card and magnetic card reader, a punched card  
19 reader could be used, or entry of a secret numeric  
20 code could be used without the use of a card reader at  
21 the various games. Rather than using a local area  
22 network such as ETHERNET, RS232 or RS422, or other  
23 kinds of links can be used between the video games and  
24 the central computer. The terminal can also be used  
25 to transmit business data to the central computer,  
26 such as numbers of games played per machine. Each  
27 central computer can transmit data relating to numbers  
28 of prepaid sales, number of decrements, sales of other  
29 items in the arcade, etc. to the local computer. The  
30 local computer can transmit this information up  
31 through the hierarchy of computers. In this manner  
32 the complete enterprise can be monitored and  
33 accurately controlled.

34 In addition, because the kind of game to  
35 be played can be changed at will, its program being  
36 downloaded from a central computer linked to each  
37 game, players at different games can play interactive  
38

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01 games with each other via the data links to the  
02 central computer.

03 In the invention described above the  
04 central computers can perform other useful and  
05 important functions, such as cash management and  
06 accounting, ordering or purchasing of goods displayed  
07 on the game display with automatic debiting of an  
08 account, seeding of pools, public credit card  
09 validation, awarding of free games or other prizes,  
10 generation of management reports, transmission of  
11 electronic mail messages between computers of the  
12 hierarchy (or if the interface is supplied with a  
13 keyboard, between electronic games), indication of  
14 alarms to remotely located attendants in case of  
15 tampering of games, storage of statistical data  
16 concerning the total number of games played and the  
17 number of games played for cash, disablement of games  
18 from a remote location, communication of the status of  
19 operation of each game, storage of data and management  
20 reports, provision of public messages and displays,  
21 etc.

22 All such variations including the  
23 provision of such means within the game are considered  
24 to be within the sphere and scope of this invention as  
25 defined in the claims appended hereto.

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The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An electronic tournament system comprising:

(a) a plurality of games of skill including means for generating signals representative of scores resulting from said games,

(b) means for displaying said scores locally at said games,

(c) means for transmitting said score signals to a central computer, whereat said scores can be compared and a winning score can be computed,

(d) means at said games for receiving signals from said computer representative of the winning score resulting from said scores, and/or announcement displays,

(e) means for displaying said winning score, and/or announcement displays, at one or more of said games.

2. A system as defined in claim 1 including computer means for storing player identification data signals and player game credit signals associated with selected player identification data signals, and further including a player identifier reader associated with each of said games for receiving a player identifier, reading said identifier, and forwarding a credit inquiry signal associated with a signal identifying said player resulting from reading said identifier to the latter computer, for receiving a credit verification or denial signal from the latter computer, and for enabling operation of the game in the event of receiving the credit verification signal.

3. A system as defined in claim 2 including one or a plurality of terminals in communication with the latter computer, means at each of the terminals for generating player identification and player credit signals, and for transmitting said identification and credit signals to the latter computer for storage therein.

4. A system as defined in claim 2 or 3, in which the central computer and the computer means are the same computer.

5. A system as defined in claim 2 or 3 in which the player identifier is a card containing player identification indicia stored thereon, the player identifier reader being comprised of a card reader.

6. A system as defined in claim 2 or 3 in which the player identifier is a card on which a magnetic recording stripe is disposed for storing a plurality of data bits representative of a particular player code, the player identifier reader being comprised of a magnetic stripe reader for reading said data bits.

7. A system as defined in claim 1, 2 or 3 in which the games of skill are electronic video games including a display for displaying game graphics, scores generating during normal operation of said game, and said winning scores and/or announcement displays.

8. A system as defined in claim 1, 2 or 3 in which the means for generating signals representative of scores is comprised of an alphanumeric or numeric keypad.

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9. A system as defined in claim 1, 2 or 3, in which each of the games includes a bus for carrying game start and game score signals, interface means connected to the bus for receiving said score signals, means for detecting a game start signal on the bus, memory means in the interface means for storing the score signals, means for initiating storage of the score signals upon detection of the game start signal on the bus, and means for transmitting the stored score signals to the central computer upon receiving a polling signal therefrom.

10. A tournament system comprising:

(a) a plurality of games,

(b) a central computer linked to said games for receiving scores achieved on said games by a player,

(c) means for storing handicap values relating to players of said games at said central computer,

(d) means at said games for transmitting a player identification signal to said computer,

whereby scores achieved on said games can be modified at the central computer by the handicap value associated with the player playing the games to produce a resultant score.

11. A tournament system comprising:

(a) a plurality of games of different kinds,

(b) a central computer linked to said games for receiving scores achieved on said games,

(c) means for storing a handicap value relating to the kind of game at either the games or the central computer,

whereby scores achieved on said games can be determined modified by the handicap value

associated with each of said games.

12. A tournament system as defined in claim 11 including means for storing a handicap value relating to players of said games at said central computer, and means at said games for transmitting a player identification signal to said computer, whereby scores achieved on said different kinds of games can be modified by the handicap values associated with the games as well as the handicap values associated with the identified players to determined resultant scores.

13. A tournament system as defined in claim 10, 11 or 12 in which the scores from said games are automatically received by said central computer by means of a local area data network.

14. A tournament system comprising:

- (a) an electronic game,
- (b) memory means for storing at least score data signals relating to scores achieved on the game, at predetermined memory locations,
- (c) a data link for communication with a central computer,
- (d) means for reading the score data stored at the predetermined memory locations, and
- (e) means for applying the score data to the data link for transmission to the central computer.

15. A tournament system as defined in claim 14 including overlay memory means for storing signals indicative of the storage locations of said scores, and interface processor means for accessing said stored signals indicative of the storage locations of said scores for generating address signals for reading a memory storing said score data



signals.

16. A tournament system as defined in claim 15 including means for storing said score data signals in parallel with said memory means, and means for addressing the latter means for storing said score data by means of said address signals.

17. A tournament system as defined in claim 16 whereby the electronic game generates signals indicative of the end of a game, further including means for detecting the end of a game signals and for causing the address signals to be generated and the stored score signals read.

18. A tournament system as defined in claim 17 in which the means for detecting is comprised of a comparator for comparing data signals generated by the game with a predetermined signal indicative of the end of a game.

19. A tournament system as defined in claim 18, the game including an address bus and a data bus connected to an address port and a data port respectively of the memory, and in which the means for storing the score data signals is comprised of a memory having its address port connectable to the address bus of the game and its data bus connectable to the data bus of the game, whereby the means for storing the score data signals is enabled to store signals stored by the memory in parallel therewith.

20. A tournament as defined in claim 19 including an interface processor address bus to which the overlay memory is connected, means for switching the address input of the means for storing the score data signals to the interface processor address bus

for receiving address signals generated under control of said processor.

21. A tournament system as defined in claim 20 including an interface processor data bus, means for switching the data input of the means for storing the score data signals to the interface processor data bus for receiving auxiliary game control data signals under control of the processor means for storage at address locations received via the interface processor address bus.

22. A tournament system as defined in claim 21 including means for receiving said auxiliary game control data signals from said central computer.

23. A tournament system as defined in claim 21 or 22 including means for switching said data and address ports to the data and address buses of said game for transmitting said auxiliary game control data to the data bus for operation of said game under address control of address signals generated under control of the interface processor means and appearing on the interface processor address bus.

24. A tournament system as defined in claim 21 or 22 in which the display data is comprised of control signals for a different game alternate to that in said former game, including means for switching said data and address ports to the data and address buses of said game for transmitting said control data to the data bus for control of said game, whereby a player of said game is enabled to play said different game.

25. A tournament system as defined in claim 14, 17 or 19 further including a player code

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identification means for reading a player identification code applied thereto, means for transmitting a code signal related to said player code to the central computer for verification thereof, means for receiving a verification code signal from the central computer and for generating and applying a "game start" pulse to the game upon receipt of the verification code signal whereby play of the game is initiated.

26. A tournament system as defined in claim 14, 17 or 19 further including a magnetic card reader for reading a card containing a magnetically encoded player code thereon, means for transmitting a code signal relating thereto to the central computer for verification thereof, means for receiving a verification code signal from the central computer and for generating and applying a "game start" pulse to the game upon receipt of the verification code whereby play of the game is initiated.

27. An electronic tournament system comprising:

(a) a plurality of electronic games each including game processor means, a display, a game data bus, a game address bus, and a game memory for storing score data appearing on the data bus at addresses specified by data appearing on the address bus,

(b) an interface circuit associated with each game comprising:

(i) interface memory means having address and data ports;

(ii) an interface address bus connected between the address ports and the game address bus,

(iii) an interface data bus connected between the data port and the game data bus,

whereby data stored in the game memory can

be similarly stored in the interface memory means,

(iv) a communication port,

(v) means for reading the data stored in the interface memory means to obtain score data and for transmitting the score data to the communication port,

(vi) a central processor,

(c) a central computer including means for communication with the interface circuits via the communication port, for transmitting polling signals to the interface circuit and thereby initiating said transmission of score data for reception by the central computer.

28. An electronic tournament system as defined in claim 27, in which each interface circuit further includes:

(vi) a player identification code reader,

(vii) means for transmitting a player identification code read by the code reader to the associated central computer,

(viii) means for receiving a player code verification signal from the associated central computer and generating a game start signal, and for transmitting the game start signal to the associated electronic game whereby a player can play a score signal generating game on the electronic game.

29. An electronic tournament system as defined in claim 28 in which each central computer includes means for storage of player identification codes and associated game credits, and for generating and transmitting a player code verification signal to a selected electronic game in the event of reception of a code from said selected electronic game which matches a stored player identification code and the existence of a game credit associated therewith.

30. An electronic tournament system as defined in claim 29 in which each central computer includes means for storage of handicap data associated with one, either or both of player codes and individual games, for receiving game score signals from the associated electronic games, and for selecting a winning game and player based on a predetermined relationship between the game scores and handicaps.

31. An electronic tournament system as defined in claim 27, 28 or 29 in which each interface circuit further includes an overlay memory for storage of pointer signals relating to score addresses of the interface memory where score data for the associated electronic game are stored, means for reading the overlay memory and for converting the pointer signals to said score address signals, means for switching the address port of the interface memory means to receive said score address signals, and means for switching the data port of the interface memory means whereby the score data stored therein may be read for transmission to the central computer.

32. An electronic tournament system as defined in claim 27, 28 or 29 in which each interface circuit further includes an overlay memory for storage of pointer signals relating to score addresses of the interface memory where score data for the associated electronic game are stored, means for reading the overlay memory and for converting the pointer signals to said score address signals, means for switching the address port of the interface memory means to receive said score address signals, comparator means connected to the interface data bus for detecting an "end of game" signal generated by the associated electronic game appearing on its data bus, and in response for

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signalling the central processor that a game has ended, whereby a data signal is transmitted to the associated central computer indicative thereof.

33. An electronic tournament system as defined in claim 27, 28 or 29 in which each interface circuit further includes an overlay memory for storage of pointer signals relating to score addresses of the interface memory where score data for the associated electronic game are stored, means for reading the overlay memory and for converting the pointer signals to said score address signals, means for switching the address port of the interface memory means to receive said score address signals, comparator means connected to the interface data-bus for detecting signals representative of an end of a game generated by the associated electronic game appearing on its data bus, and in response for signalling the central processor that a game has ended, whereby a data signal is transmitted to the associated central computer indicative thereof, means for switching the address and data ports to receive address and data signals for storage of the latter data signals in the interface memory means at addresses specified by the latter address signals, means for storage of said latter address and data signals, and means for switching the interface memory data port to the game data bus to output said data signals thereon and thereby control operation of the electronic game.

34. An electronic tournament system as defined in claim 27, 28 or 29 in which each interface circuit further includes an overlay memory for storage of pointer signals relating to score addresses of the interface memory where score data for the associated electronic game are stored, means for reading the overlay memory and for converting the pointer signals

to said score address signals, means for switching the address port of the interface memory means to receive said score address signals, comparator means connected to the interface data bus for detecting signals representative of an end of a game, generated by the associated electronic game appearing on its data bus, and in response for signalling the central processor that a game has ended, whereby a data signal is transmitted to the associated central computer indicative thereof, means for switching the address and data ports to receive address and data signals for storage of the latter data signals in the interface memory means at addresses specified by the latter address signals, means for receiving at least said latter data signals from the associated central computer, means for storage of said latter address and data signals, and means for switching the interface memory data port to the game data bus to output said data signals thereon and thereby control operation of the electronic game.

35. An electronic tournament system comprising:

- (a) a plurality of central computers,
- (b) a plurality of games of skill each including means for generating signals representative of scores resulting from said games and for displaying said scores on a display,
- (c) each game including means for transmitting said score signals to at least one of the central computers, whereby groups of said games are associated with each central computer, said central computers being adapted to determine winning scores from each group of games,
- (d) means at each of said games for receiving signals from the central computers associated therewith representative of winning score

announcements for display thereof on local displays.

36. An electronic tournament system as defined in claim 35 further including one or a plurality of regional computers with which one or a plurality of groups of central computers can communicate, means for transmission of winning score data signals from the central computers to the one or plurality of regional computers whereby a winning score can be computed and corresponding announcement signals transmitted to the central computers for transmission to and display at the games.

37. An electronic tournament system as defined in claim 36, including means at each central computer for storage of player codes and associated game credits, means at each game for reading cards carrying individual player codes, for transmitting a verification inquiry to an associated central computer, for receiving a verification signal from the associated central computer and in response for initiating operation of said game.

38. An electronic tournament system as defined in claim 37 including means at each central computer for storing handicap data associated with each stored player code, and for determining said winning scores based on a predetermined combination of scores achieved on the initiated games with said handicap data.

39. A tournament system as defined in claim 21 or 22 including means for switching said data ports to the data bus of said game for transmitting said display data to the data bus for display at said game under address control of address signals generated under control of the interface processor



from data signals received from the central computer.

40. An electronic tournament system comprising:

(a) a plurality of games of skill including means for automatically generating signals representative of scores resulting from said games as said games are played,

(b) means for transmitting signals representative of final scores resulting from said games to a central computer, whereat said scores can be compared and a winning score can be computed.

41. An electronic tournament system as defined in claim 40 including a data bus carrying said score signals and means for automatically transmitting said final score signals upon completion of said games.

42. A tournament system comprising:

(a) an electronic game for automatically generating score signals as the game is played, and

(b) means for applying the score signals to a data link port for transmission to a central computer.

43. A tournament system as defined in claim 42 further including means for identifying a player and for applying a player identification signal to said data link port.

44. A tournament system as defined in claim 43 further including means for receiving a player verification signal via the data link port and for enabling the game upon receipt of said verification signal.

45. A tournament system as defined in claim 42 or 43 including keyboard means for generating signals representative of the operation of keys on said keyboard and applying said signals to the data link port whereby command or instruction or informational signals are transmitted to the central computer.

46. A tournament system as defined in claim 42 or 43 further including means connected to said game for receiving display signals from the central computer, and for displaying said signals on a display associated with the game.

47. A tournament system as defined in claim 42 or 43 further including means in communication with said game for storing game command signals, and means in communication with said game for storing display signals, a keyboard means, processor means for communication with the storing means and keyboard means for causing operation of a different play and different display on the display of said game upon operation of the keyboard by said player.

48. A tournament system as defined in claim 42 or 43 further including means in communication with said game for storing game command signals, and means in communication with said game for storing display signals, a keyboard means, processor means for communication with the storing means and keyboard means for causing operation of a different play and different display on the display of said game upon operation of the keyboard by said player, and means for receiving a player verification signal via the data link port and for enabling the game upon receipt of said verification signal.

49. A tournament system as defined in claim 21, 41 or 43 further including a first random access memory for storing first display operation signals, a multiplexer, means for applying the first display operation signals to one input port of the multiplexer, means for applying game display operation signals from the game to a second input port of the multiplexer, a processor for enabling the multiplexer to apply either the first display operation signals or the game display operation signals to video display operation circuitry of said game.

50. A tournament system as defined in claim 21, 41 or 43 further including a random access memory for storing score and auxiliary game control signals, a keyboard, a first random access memory for storing first display operation signals, a multiplexer, means for applying the first display operation signals to one input port of the multiplexer, means for applying game display operation signals from the game to a second input port of the multiplexer, a processor for enabling the multiplexer to apply either the first display operation signals or the game display operation signals to video display operation circuitry of said game, and for enabling operation of an auxiliary game in place of the former game upon operation of said keyboard.

51. A tournament system as defined in claim 21, 41 or 43 further including a random access memory for storing score and auxiliary game control signals, a keyboard, a first random access memory for storing first display operation signals, a multiplexer, means for applying the first display operation signals to one input port of the multiplexer, means for applying game display operation signals from the game to a second input port of the

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multiplexer, a processor for enabling the multiplexer to apply either the first display operation signals or the game display operation signals to video display operation circuitry of said game, and for enabling operation of an auxiliary game in place of the former game upon operation of said keyboard, and means for receiving said auxiliary game control signals and said first display operation signals from said central computer.

52. A tournament system as defined in claim 42 further including means for storing alternate game control signals whereby an alternate game can be played generating alternate scores.

53. A tournament system as defined in claim 52 including means for enabling said alternate game control signals under control of the control computer.

54. A tournament system as defined in claim 42 further including means for storing alternate control and display signals, means for enabling communication with the central computer under control of the alternate control signals and display of an alternate display on the game display under control of the alternate display signals.

55. A method of operating a tournament comprising:

- (a) linking a plurality of games in which scores are automatically generated, to a central computer,
- (b) transmitting at least the final scores from the games to the central computer,
- (c) comparing the final scores from said games at said computer.

(d) transmitting a display message signal to each of the games for display at said games from the central computer at predetermined instances.

56. A method of operating a tournament as defined in claim 55 comprising entering individual player codes at each of the games taking part in the tournament, transmitting signals representative of said codes to said computer, comparing the player codes with predetermined codes at said computer, transmitting verification signals from said computer to individual ones of said games in the event corresponding individual ones of the player codes match said predetermined codes, and enabling said individual ones of said games receiving said verification signals.

57. A method of operating a tournament as defined in claim 56 including storing handicap data relating to each game at either of the corresponding game or the central computer, and storing handicap data relating to said players at the central computer, and modifying the scores by either or both of the game and player handicap data prior to comparison of the final scores.

58. A method of operating a tournament comprising:

(a) linking a plurality of games in which scores are automatically generated and displayed on a local display, to a central computer,

(b) transmitting a display message signal to any or each of the games for display thereat in place of the local display generated by the game.

59. A method of operating a tournament as defined in claim 55, 56 or 58 including transmitting

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said display message signal to said central computer from a regional computer.

60. A method of operating a tournament as defined in claim 55, 56 or 58 including generating command instruction or informational signals on keyboards at the games and transmitting them to the central computer for enabling operation thereof in a predetermined manner.

61. A method of operating a tournament as defined in claim 56 or 57 including storing credit signals associated with predetermined ones of said player codes at said central computer, and decrementing individual ones of the credit signals with predetermined values upon receiving said signals representative of individual player codes and matching said received player codes and the stored player codes.

62. A method as defined in claim 55, 56 or 58 including printing a message or ticket at at least a predetermined one of said games for retaining by a player associated with at least said predetermined game.

63. A tournament system as defined in claim 42, 43 or 44 including a printer means at said game for receiving data signals from the data link port for printing a message or ticket thereon in response thereto.

64. A tournament system as defined in claim 14, including means for manually inputting the score data signals into the predetermined memory locations.

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65. A tournament system as defined in claim 42 or 44 including means for manually inputting score signals to the applying means for transmission to the central computer.

66. A tournament system as defined in claim 1, 10, or 11, in which the games of skill are exercise machines which provide a score signal indicative of skill level, strength or time of operation.

67. A tournament system as defined in claim 14, 27, or 35, in which the games of skill are exercise machines which provide a score signal indicative of skill level, strength or time of operation.

68. A tournament system as defined in claim 42, 55, or 58, in which the games of skill are exercise machines which provide a score signal indicative of skill level, strength or time of operation.

69. A method as defined in claim 55 or 58 including manually keying the scores on a keyboard whereby they can be transmitted to the central computer.

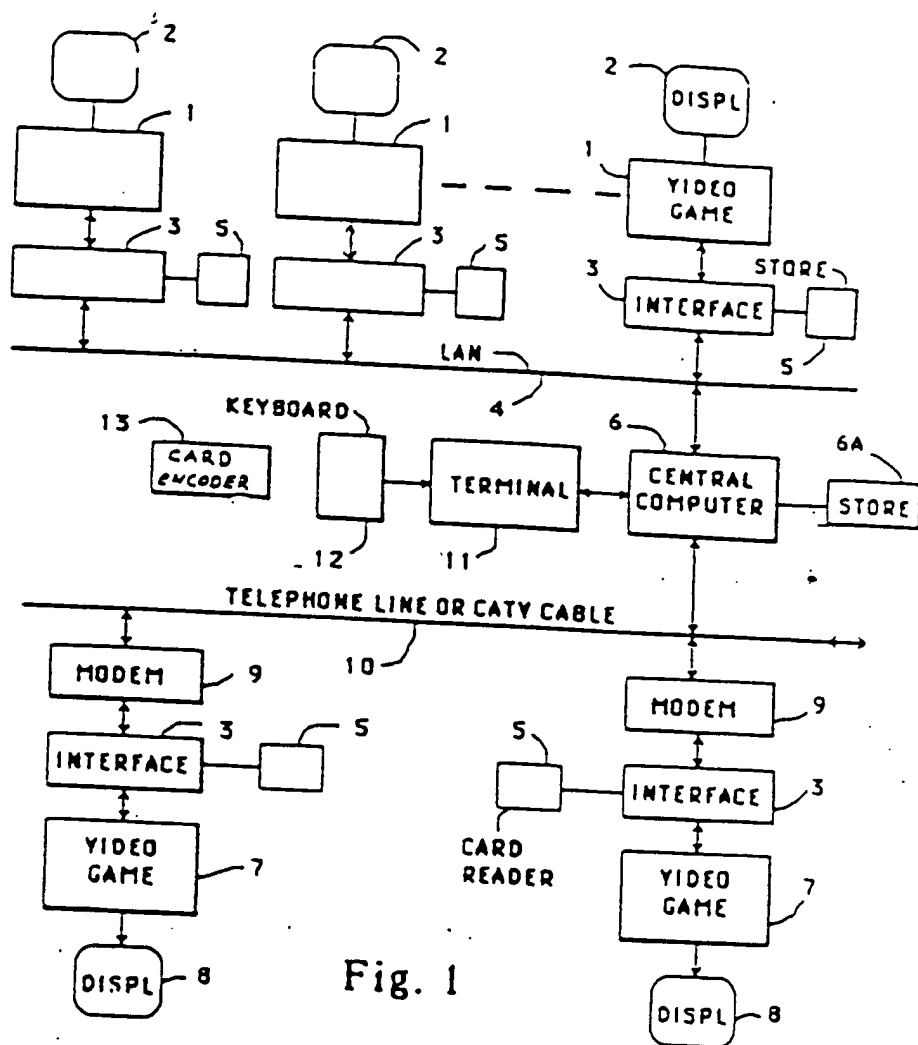


Fig. 1

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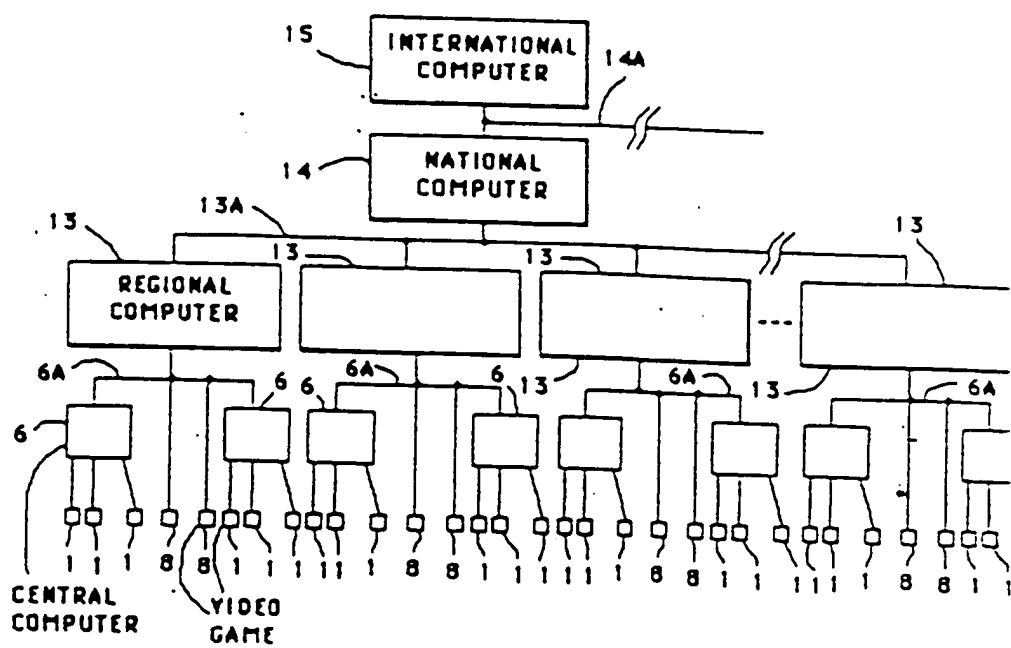


Fig. 2

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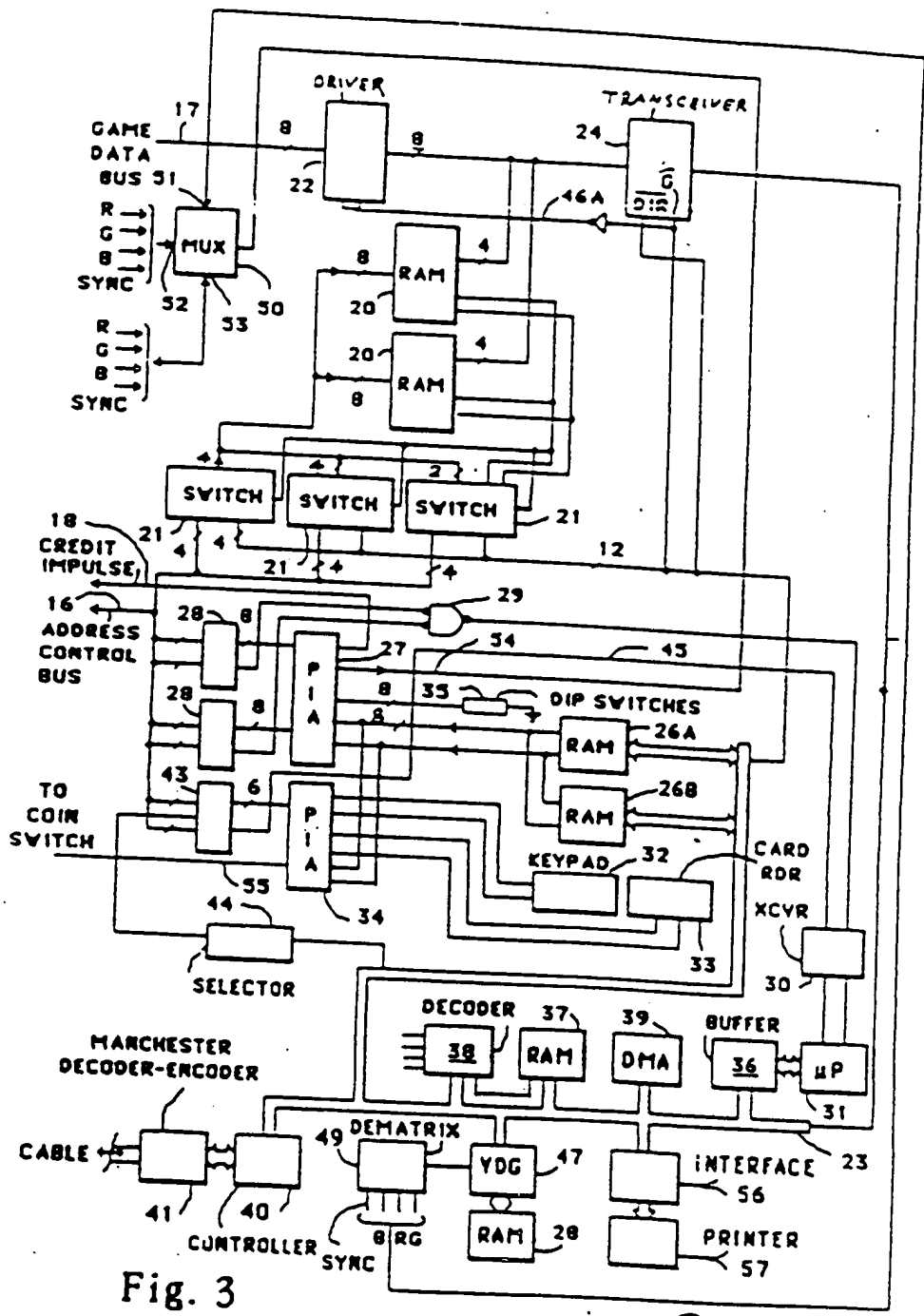


Fig. 3

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